

MEMORANDUM

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| To: | Dana Bayuk Oregon Department of Environmental Quality(DEQ) | Date: | February 18, 2016 |
| From: | Pradeep Mugunthan, John Renda, John Edwards, Mike Riley, Mike Gefell, and Miao Zhang Anchor QEA, LLC | Project: | 000029-02.41 |
| Cc: | Henning Larsen (DEQ); Sean Sheldrake and Eva DeMaria (U.S. Environmental Protection Agency Region 10); Matt Gamache, Scott Coffey, and Lance Peterson (CDM Smith); Ben Hung, Carl Stivers, Binglei Gong, and Jen Mott (Anchor QEA, LLC); Bob Wyatt (NW Natural); Patty Dost and Sarah Riddle (Pearl Legal Group); Myron Burr (Siltronic); James Peale and Mike Murray (Maul Foster Alongi); Rob Ede (Hahn and Associates, Inc.) | | |
| Re: | Additional Testing and Data Collection Proposal to Constrain Fill Water Bearing Zone Hydraulic Conductivities and Recharge Rate in Gasco Groundwater Model | | |

The Oregon Department of Environmental Quality (DEQ) and U.S. Environmental Protection Agency Region 10 (USEPA) raised several concerns¹ on the Gasco Groundwater Model calibration presentation on June 15, 2015. A series of technical exchanges have taken place subsequently², and an approach has been agreed upon to address these concerns with the exception of the recharge rate specified in the model for the unpaved areas in the Fill Water-Bearing Zone (WBZ) and calculation of precipitation water budget components for the Fill WBZ³.

DEQ and USEPA are requiring that NW Natural increase the recharge rate specified for the unpaved areas in the model for the Fill WBZ. The current model uses an infiltration rate of about 20% of precipitation in unpaved areas. DEQ's position is that approximately 20 inches per year is a reasonably conservative estimate of recharge for modeling purposes (see e-mail

¹ E-mail from Dana Bayuk to Pradeep Mugunthan on June 26, 2015, with DEQ comments and USEPA's (CDM Smith) comments attached as a technical memorandum

² September 2, 2015 NW Natural memorandum in response to comments received from DEQ on June 15 modeling presentation (to Dana Bayuk); DEQ and USEPA response to NW Natural memorandum requesting additional information to be completed (Tables 1 and 2; e-mail from Dana Bayuk to Pradeep Mugunthan on October 6, 2015); NW Natural's submittal of Table 1 and partially completed Table 2 (e-mail from Pradeep Mugunthan to Dana Bayuk on November 11, 2015); Modeling Workshop held at Anchor QEA's Portland office on December 1, 2015 to discuss outstanding concerns and proposed resolutions

³ E-mail from Dana Bayuk to Pradeep Mugunthan on January 26, 2016

from Dana Bayuk to Pradeep Mugunthan on October 6, 2015), which would require an increase in the recharge rate to about 50% of precipitation. The model cannot be calibrated to the site Fill WBZ groundwater elevation data using a higher infiltration rate without proportionally increasing the hydraulic conductivity of the Fill WBZ. The hydraulic conductivity of the Fill WBZ in the current model calibration (presented to DEQ on June 15, 2015) ranges from 1 to 40 feet per day and provided the best fit to observed Fill WBZ water levels.

Before altering the existing Fill WBZ hydraulic conductivity values (which were established based on site-specific testing and water level data) for model calibration to a higher recharge rate, we believe actual hydraulic conductivity should be verified. NW Natural is therefore proposing to conduct single-well, constant-rate pumping tests in selected Fill WBZ monitoring wells at the site. Model calibration will also be supplemented with the groundwater elevation data from the transducers installed in February 2016 in five additional Fill WBZ wells located on the Gasco and Siltronic properties. These data will also provide a constraint on the recharge specified in the model.

Constant Rate Pump Tests

Single-well, constant-rate pumping tests are proposed in up to ten Fill WBZ wells (see Figure 1). The following list of wells were selected:

- MW-08-29
- MW-09-29
- MW-11-32
- MW-19-22
- MW-40F
- NWN-7-30
- NWN-8-30
- NWN-13-23
- OW-1F
- OW-7-17

These wells were selected to represent a range of conditions in the Fill WBZ, including some shoreline wells where slug tests were conducted in 2011. It is expected that the Fill WBZ wells will only be able to sustain relatively low pumping rates without going dry. The tests will target an extraction rate of 0.5 gallons per minute (gpm) but may be adjusted up or down

within the first few minutes of the test depending on the response of the well. The minimum test duration will be 20 minutes but will be extended if it appears that the well can sustain extended pumping. Extracted water will be contained and treated through the Siltronic pre-treatment plant. The operation of hydraulic control and containment system is not expected to interfere with the Fill WBZ tests, and therefore will be continued uninterrupted.

Standard pumping test analysis procedure will be used to determine the hydraulic conductivities in the Fill WBZ. Both pumping and recovery data will be analyzed, and a technical memorandum will be prepared to summarize the findings. We anticipate that the tests can be completed within 30 days of receiving approval from DEQ.

The water balance to document the components of recharge (see Table 2) requested by DEQ will be completed after Fill WBZ water level data and findings from the tests above become available. We anticipate that this will be completed within 30 days of completion of the tests.



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Model Domain
 ● Proposed Single Well Test Locations

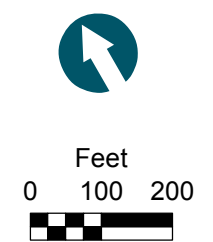


Figure 1
Proposed Locations for Single-well, Constant-rate Pumping Tests in the Fill Water Bearing Zone
NW Natural Gasco Site